Roll No:

ANNA UNIVERSITY CHENNAI – UNIVERSITY DEPARTMENTS

B.E. DEGREE EXAMINATIONS, NOVEMBER 2010

COMPUTER SCIENCE AND ENGINEERING

III Semester

CS 9201 Design and Analysis of Algorithms

Time : 3 Hours Max. Marks 100

PART – A (10 x 2 = 20 marks)

Answer all questions

1. Find the order of $n^5 + \log n + 500$
2. Write an algorithm to find the maximum of a given list of numbers. How many comparisons does your algorithm do?
3. What are the key ingredients that an optimization problem must have for it to be solved using dynamic programming technique?
4. List a common subsequence of the strings: ABABBBAABBA and ABBBAAABA.
5. Define the greedy-choice property.
6. How many scalar multiplications are required to multiply two 2 X 2 matrices using Strassen's algorithm? Compare it with the number of scalar multiplications required using the usual matrix multiplication algorithm.
7. Formulate a linear program problem in standard form.
8. How many comparisons are required in the Naive String matching algorithm to look for a m-character pattern in a n-character string?
9. Define the following classes of problems: P and NP.
10. State any one NPC problem.

PART –B (5 x 16 =80 Marks)

11. (i) Write the randomized QUICKSORT algorithm and analyze it for its average-case behaviour. (8)

(ii) State the activity selection problem and write an iterative algorithm to solve this problem using the greedy approach. Given the following 8 activities with the start and finish time given within parenthesis, solve the above problem.(1, 5), (2, 3), (1,4), (6,7), (9, 11),(4, 8), (3, 6), (10,12) (4 + 4)

12. (a) (i) Write an algorithm which computes the sum of two matrices: C = A + B Analyze it for the best-case, average-case and worst-case behaviour. (8)

(ii) Solve the recurrence relation assuming that n is an exact power of 2. (8)

$T(n) = 2\,T(n/2) + n$ if $n = 2^k$, for $k > 1$

$T(n) = 2$ if $n = 2$

(OR)

(b) (i) Solve the following system of linear equations using LUP decomposition: (8)

$x_1 + 5x_2 + 4x_3 = 12$

$2x_1 + 3x_3 = 9$

$5x_1 + 8x_2 + 2x_3 = 5$

(ii) Draw the Huffman tree for the following frequency of occurrences of the characters and show the encoding of each character.

A : 12, B: 5, C : 7, D :8, E:18 (8)

13. (a) State the matrix-chain multiplication problem. Write an algorithm that computes an optimal order for multiplying that chain of matrices. Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5, 10, 3, 2, 4) (8 + 8)

(OR)

(b) (i) Write the Counting-Sort algorithm. Is it stable? Illustrate its operations on the array {5, 1, 3, 2, 1, 5, 5, 4, 3, 1} Show the intermediate results. (8)

(ii) Compute the expected number of heads when a fair coin is flipped n times. What are the random variables and indicator random variables that you have used? (8)

14. (a) Solve the following linear program using SIMPLEX: (16)

Maximize $18 x_1 + 12.5 x_2$ subject to

$$x_1 + x_2 \leq 20$$

$$x_1 \leq 12$$

$$x_2 \leq 16$$

$$x_1 , x_2 \geq 0$$

(OR)

(b) (i) Write down the KMP-Matcher and Compute-Prefix –Function algorithms that are used in the KMP Pattern matching algorithm. (8)

(ii) Compute the prefix function for the pattern ABABBABB (8)

15. (a) State any one NPC problem and prove that it is NP-Complete. Mention clearly any assumption made. (16)

(OR)

(b) What are approximation algorithms? Write down an approximation algorithm for any NPC problem of your choice and compute its approximation ratio. (16)

Anna University

Department of Computer Science and Engineering

B.E (CSE) III SEMESTER 'H' BATCH

CS 9201 Design and Analysis of Algorithms

15-09-2010 TEST II **Max. Marks: 25**

1) Which statement of the **COUNTING-SORT** algorithm made it stable? Illustrate the operation of the above algorithm on the list **{6, 1, 2, 3, 6, 1, 3, 4, 3, 2}** Show the contents of the temporary array C whenever it gets updated and also the contents of the output array **B** after **5** elements of the input array are processed.

(1+4)

2) Briefly explain, with the "matrix chain multiplication" problem, the key characteristics that a problem must have for dynamic programming to be a viable solution technique.

(5)

3) Determine an LCS of <1, 0, 1, 0, 1, 1> and <0, 0, 1, 1, 1>

(5)

4) Construct the Huffman tree and arrive at the Huffman code for the following set of frequencies based on the first 8 Fibonacci numbers. a: 1, b:1, c:2, d:3, e:5, f:8, g:13, h:21

(5)

5) Sketch a method to find a shortest path between two vertices in an undirected graph using the Greedy technique. Verify it with an example of your own with a graph having 5 vertices and 7 edges. No need to give the algorithm or the data structure.

(5)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS9201- Design and Analysis of Algorithms

Third Semester B.E(CSE) – G batch

Time: 1 hour **Marks: 20**

1. Which statement of the **COUNTING-SORT** algorithm made it stable? Illustrate the operation of the above algorithm on the list **{6, 1, 2, 3, 6, 1, 3, 4, 3, 2}** Show the contents of the temporary array **C** whenever it gets updated and also the contents of the output array **B** after **5** elements of the input array are processed. (1+4)

2. Let X[1..n] and Y[1..n] be two arrays, each containing n numbers already in sorted order. Give an O (log n) time algorithm to find the median of all 2n elements in arrays X and Y. (5)

3. Show that RANDOMISED- QUICK Sort's expected running time is $\Omega(n \log n)$. (10)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ANNA UNIVERSITY CHENNAI
CS9207 – ALGORITHMS LABORATORY - ASSESSMENT – 1
BE CSE – III semester (Common to G, H & I Batches)

Time: 90 minutes **Marks: 25**

Date: 26th August 2009

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1. Prove that number of basic operations performed to determine the way to multiply a chain of matrices using dynamic programming strategy is $O(n^3)$ **(7)**

   A1 = 10 * 5, A2 = 5* 3, A3 = 3* 7, A4 = 7 * 2.

   Print the way in which you would perform the multiplications by showing a delimiter between the individual matrices. **(3)**

   After determining the chain, declare the matrices and prove that the number of multiplications required to multiply two matrices can be reduced from $O(n^3)$ if the elements of the matrices contains 0's or 1's. (3 + 2)
2. Write a recursive function that reverse the digits of an array by taking the number of elements and the array as parameters. Estimate the time complexity of this algorithm in terms of its basic operation. State your conclusions on the following data (7 + 3)

S.No	Number of Elements	Element's Nature	Number of Basic Operations
1	10	Elements are unique	
2	10	Elements are same	

Evaluation Criteria	Comments		Evaluation Criteria	Comments	
	Q 1	Q2		Q 1	Q 2
First part done?			Second part done?		
Code complete? I			Third part done?		
II					
III					
Compiler Error I			Logical Error / Partial complete I		
II			II		
III			III		

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ANNA UNIVERSITY CHENNAI
CS9207 – ALGORITHMS LABORATORY - ASSESSMENT – 1
BE CSE – III semester (Common to G, H & I Batches)

Time: 90 minutes **Marks: 25**

Date: 26th August 2009

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1. Write a recursive function BinRec(int n), which takes a decimal integer 'n' as the parameter and returns the number of binary digit's in its binary representation. Estimate and determine the number of basic operations (8 + 2)
   Example: I/P : 7 => Binary is 111 => 3 digits
2. Compare the worst case, performance of implementing the matrix chain multiplication algorithm using
   a. Recursion – Without implementing a table (5)
   b. Iteration – By implementing a tabular approach (5)

   Parenthesize the matrices and print the order in which the matrices would be combined for multiplication
   Tabulate your results for both the print and the computation algorithm (3 + 2)

S.No	Chain Length	Recursion's Basic operations	Iteration's Basic Operations	Print's Basic operation	
1	6				
2	12				

Evaluation Criteria	Comments		Evaluation Criteria	Comments	
	Q 1	Q2		Q 1	Q 2
First part done?			Second part done?		
Code complete? I			Third part done?		
II					
III					
Compiler Error I			Logical Error / Partial complete I		
II			II		
III			III		

Roll No.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ANNA UNIVERSITY, CHENNAI – 25

III Semester B.E CSE

CS9207 – Algorithms Laboratory

Assessment I

Time: 1.30 minutes Marks: 25

Date: 6th September 2010

Instructions:

- Name your files for questions 1 and 2 as Txxxx1.c and Txxxx2.c, where xxxx = last 4 digits of your roll number
- Include your roll number and name as a first comment line in both your programs

1. Use Divide and Conquer strategy to compute the set A∩B and AUB. The input sets A and B may be in sorted or unsorted order and will have 'n' elements each. Analyse the performance of your algorithm and prove that the sets A∩B and AUB can be computed in O(n) time if A, B are sorted and in O(n log n) time if unsorted by implementing a program in C. Output the array A∩B and AUB and also fill up the following table for the number of basic operations. 5+3+2

	Number of Basic operations if A, B is sorted	Number of Basic operations if A, B is unsorted
A ∩ B		
AUB		

2. Write a program in C that uses the concept of Dynamic programming to find the optimum way to multiply a given chain of matrices. Determine the number of basic operations that this algorithm uses to compute. Output the matrix containing the multiplications required and the way parenthesisation should be performed. 7+3+2 +3

   Sample Data:

   A1 = 3 X5, A2 = 5 X 6, A3 = 6 X 35, A4 = 35 X 10, A5 = 10 X 15, A6 = 15 X 75, A7 = 75 X 25

Roll No.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ANNA UNIVERSITY, CHENNAI – 25

III Semester B.E CSE - H Batch

CS9207 – Algorithms Laboratory

Assessment II

Time: 90 minutes Marks: 25

Date: 18th October 2010

Instructions:

- Name your files for questions 1 and 2 as Txxxx1.c and Txxxx2.c, where xxxx = last 4 digits of your roll number
- Include your roll number and name as a first comment line in both your programs

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1. Solve the following using LUP decomposition and also compute the inverse of matrix A. (10 + 2+ 3)

$$2x + 3y + 4z = 7$$

$$3x - y + 2z = 8$$

$$x + 2y - 3z = -7$$

Print the following

a. The matrices L, U, P

b. The column vector y

c. The column vector x

d. The no. of basic operations

2. Use Greedy strategy to give change with maximum number of coins using the denominations 0.25, 0.5, 1, 2, 5 and ensuring that at least 1 coin is there in every denomination and determine the number of basic operations that this algorithm will do to solve the problem (5 + 2 + 3)

Roll No.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ANNA UNIVERSITY, CHENNAI – 25

III Semester B.E CSE - I Batch

CS9207 – Algorithms Laboratory

Assessment II

Time: 90 minutes
Date: 20th October 2010

Marks: 25

Instructions:

- Name your files for questions 1 and 2 as Txxxx1.c and Txxxx2.c, where xxxx = last 4 digits of your roll number
- Include your roll number and name as a first comment line in both your programs

1. Use KMP string matching algorithm to check whether a given pattern is there in the string or not. Print the prefix function and position of multiple occurrences of the pattern in a given text. Have an input text consisting of multiple occurrences of the pattern. Prove that the time complexity of this algorithm is O(n) (5 + 3 + 2)

2. Use Dynamic programming strategy to determine the longest common subsequence between the two strings "x" and "y" respectively. Assume your input has multiple longest common subsequences and your print function should print all such occurrences by traversing in the table. Determine the number of basic operations. Print the table, the multiple LCS, the basic operations. (7 + 5 + 3)

COLLEGE OF ENGINEERING, ANNA UNIVERSITY.
DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY
B.Tech(IT) G and H batch - 15/9/2010
II ASSESMENT- CS9201 Design and Analysis of Algorithms

Marks:20 **Hours: 50 mins**

1. Prove that any comparison sort algorithm requires $\Omega(n \log n)$ comparisons in the worst case. (2)

2. Define the optimal substructure property of an LCS. (2)

3. Write a divide-and-conquer algorithm for the selection problem and prove that the expected asymptotic running time is $\Theta(n)$. (5)

4. Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5,3,2,4,3) (5)

5. Solve the equation

$$\begin{pmatrix} 1 & 5 & 4 \\ 2 & 0 & 3 \\ 5 & 8 & 2 \end{pmatrix} \begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix} = \begin{pmatrix} 12 \\ 9 \\ 5 \end{pmatrix}$$

By using an LUP decomposition. (6)